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**Columbia River Sediment,
Water, and Biological Data Summary
Weyerhaeuser Chlor-Alkali Plant
Longview, Washington**

**Prepared by
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Executive Summary

Weyerhaeuser Company owns and operates a Chlor-Alkali plant at its forest products complex in Longview, Washington. The mercury electrolytic cell process was used at the plant from the mid-1950s to the early 1970s to produce chlorine and sodium hydroxide (caustic).

This report summarizes past sampling of water, sediment, and biological tissue collected from the Columbia River near the Weyerhaeuser Chlor-Alkali plant. Specifically, this report documents ten studies that included the analysis of these media for mercury. A total of 61 sediment samples, 36 surface water samples, and 70 biological tissue samples were collected between 1970 and 1993 and are summarized in this report.

A compilation of these studies has generally characterized mercury concentrations in river sediments and biological tissue as being highest in the early 1970s. During this time, mercury concentrations near the plant were comparable to those detected upstream and downstream of the plant.

In 1980, the eruption of Mt. Saint Helens caused emergency dredging to occur in the Columbia River channel and side channel near the Chlor-Alkali plant outfalls. Studies performed after 1980 indicated a decline of mercury concentrations in sediment and biological samples.

Recent sampling studies indicated mercury concentrations in sediment and biological samples collected near the plant to be comparable to those upstream and downstream of the plant. A sediment sampling event occurred in 1992 during the removal of the No. 1 Cell Room outfall and diffuser that indicated mercury concentrations higher than other areas near the plant. Samples collected before and after the removal of the No. 1 Cell Room diffuser may have included material previously contained in the outfall and/or diffuser and may not accurately represent the river sediment.

Historic and recent sampling of surface water indicated all samples collected upstream, downstream, and near the plant were all below the method detection limit (MDL) except one sample, located near the chlorine plant discharge, which contained 0.001 milligram per liter (mg/L) mercury.

Introduction

Background

Weyerhaeuser Company owns and operates a Chlor-Alkali plant at its forest products complex in Longview, Washington. The location of the Chlor-Alkali plant is shown in Figure 1. Chlorine and sodium hydroxide (caustic) were initially produced at the plant using the mercury electrolytic cell process. Concerns over potential releases of mercury into the environment prompted Weyerhaeuser to convert to a different process technology (that is, diaphragm cells) and sample various media to determine mercury concentrations near the Chlor-Alkali plant.

Purpose

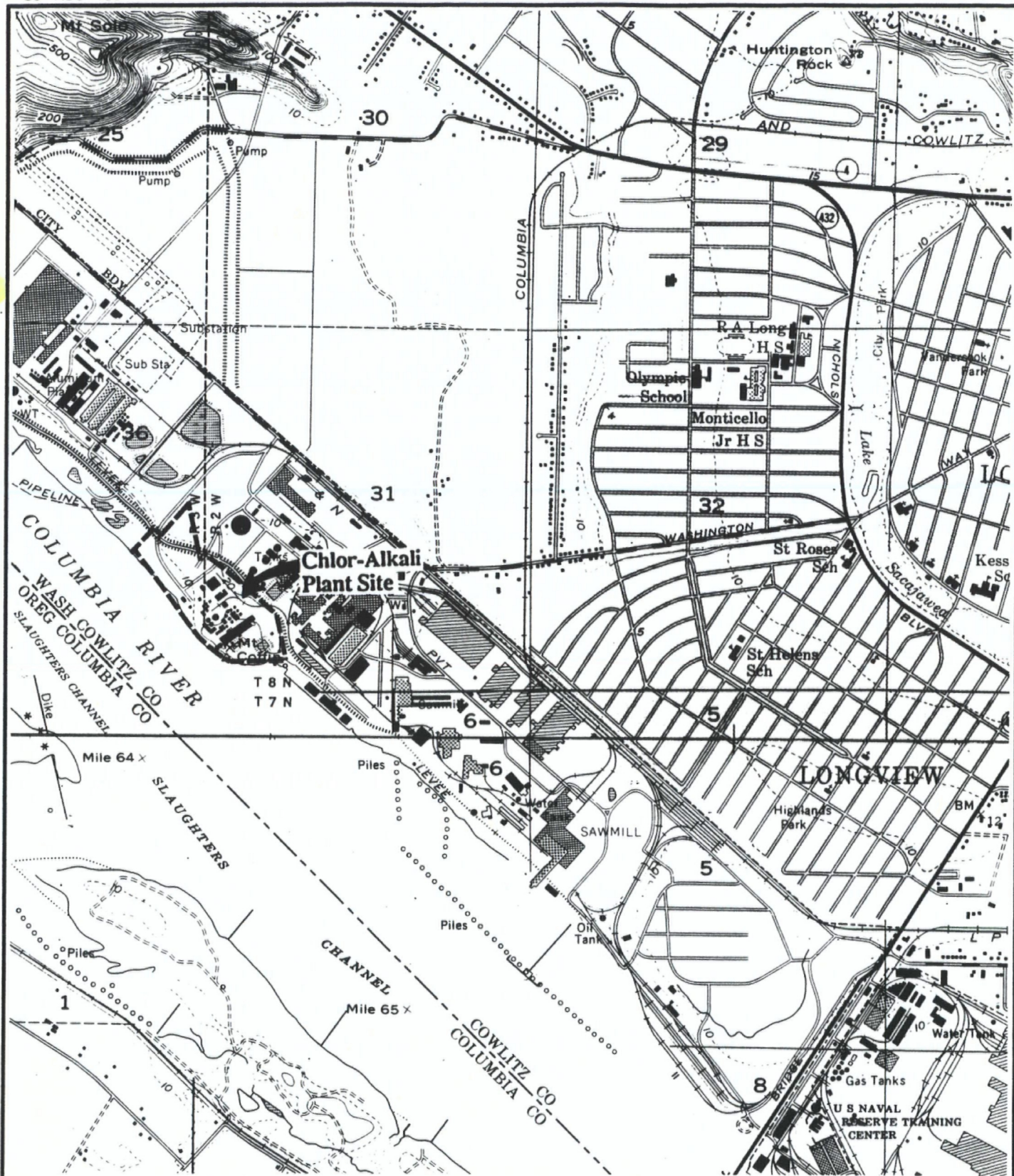
The purpose of this report is to summarize past sampling and analysis of water, sediment, and biological tissue collected from the Columbia River near the plant. This report is intended to provide the Environmental Protection Agency (EPA) with additional information regarding mercury concentrations in the Columbia River and supplement information previously provided to the State of Washington's Department of Ecology (DOE) in the April 1992 draft Remedial Investigation/Feasibility Study (RI/FS) work plan.

Site History

In the mid-1950s, the Weyerhaeuser Company constructed and began operating a Chlor-Alkali plant in Longview, Washington, to produce chlorine and sodium hydroxide (caustic) for the company's pulp and paper mills. Operations at the No. 1 Cell Room commenced in the fall of 1958. The plant was expanded in 1966 with the addition of the No. 2 Cell Room.

The technology used to produce chlorine and caustic available during the late 1950s was the mercury electrolytic cell process. This two-part electrolytic process used a brine electrolyzer and an amalgam decomposer. Salt brine was introduced into the electrolyzer, which contained mercury as a flowing cathode. Current applied to the mercury passed through the brine, liberating chlorine gas at fixed graphite anodes. Sodium ions from the brine amalgamated with the mercury and flowed into the graphite-filled decomposer. Fresh water that was fed into the decomposer reacted with the amalgam to form hydrogen gas and caustic. The elemental mercury was then recycled to the electrolyzer.

As a result of the electrolytic cell process, trace amounts of mercury were present in the depleted salt brine and caustic. Trace mercury in these solutions was allowed to settle in recovery tanks before the solution was pumped to process areas where the salt brine was resaturated and caustic was stored.



0 1000 2000



SCALE IN FEET

LEGEND

----- APPROXIMATE SITE BOUNDARY

FIGURE 1

Location Map®

WEYERHAEUSER CHLOR-ALKALI PLANT
LONGVIEW, WASHINGTON

CH2M HILL

Within the No. 1 Cell Room, spilled process fluids would flow or be swept toward collection trenches. The trenches drained to overflow sumps where elemental mercury was collected and processed back into the production cells. From 1958 to 1966, aqueous waste streams from the No. 1 Cell Room were discharged to a ditch located between the salt-dissolving basin and the roll grinder. The effluent flowed through the ditch down the riverbank into the Columbia River. In 1966, a diffuser was installed to facilitate direct discharge below the surface of the river.

The potential for mercury releases from the No. 2 Cell Room was considerably less than from the No. 1 Cell Room because of differences in building construction and the duration of process operations. Collection trenches in the No. 2 Cell Room had synthetic liners that reduced the potential for leakage. These liners are still in good condition. Aqueous waste streams from the No. 2 Cell Room were discharged to the Columbia River through an outfall and diffuser from 1966 until 1976.

During the 1970s, measures were instituted to eliminate mercury discharged to the Columbia River from the plant. These measures included installation of control devices to condense mercury in the effluent before discharge and the diversion of aqueous process waste streams that had previously discharged to the Columbia River into surface ponds located east of the No. 1 Cell Room. By the mid-1970s, the No. 1 Cell Room had ceased operation and the No. 2 Cell Room was converted to diaphragm cells.

Site Setting

The area of focus for this report includes the Columbia River near the Chlor-Alkali plant (at approximately River Mile 63.5); upstream of the plant (upstream of River Mile marker 64); and downstream of the plant (downstream of River Mile marker 63).

Annual precipitation in Cowlitz County is about 45 inches, with the maximum rainfall occurring in December and the minimum in July. Average temperatures range from 38 degrees Fahrenheit (°F) in January to 64°F in July. Mean wind speed ranges from a high of 8 knots in December to a low of 5.1 knots in August.

The Columbia River borders Weyerhaeuser's southwestern property boundary and receives discharge from the Cowlitz River, at approximate River Mile marker 68, upstream of the Weyerhaeuser forest products complex. The Columbia River stage is affected by both tidal fluctuations and changes in river flow. The average flow rate for the Columbia River near the site from 1973 to 1979 was 224,000 cubic feet per second.

A recent U.S. Army Corps of Engineers (COE) map indicates the Columbia River is approximately 2,500 feet wide near the Chlor-Alkali plant and ranges in depth from approximately 34 to 48 feet (Figure 2). The main navigational channel ranges from a minimum of 40 to 48 feet and is approximately 1,500 feet from the shore near the plant. As

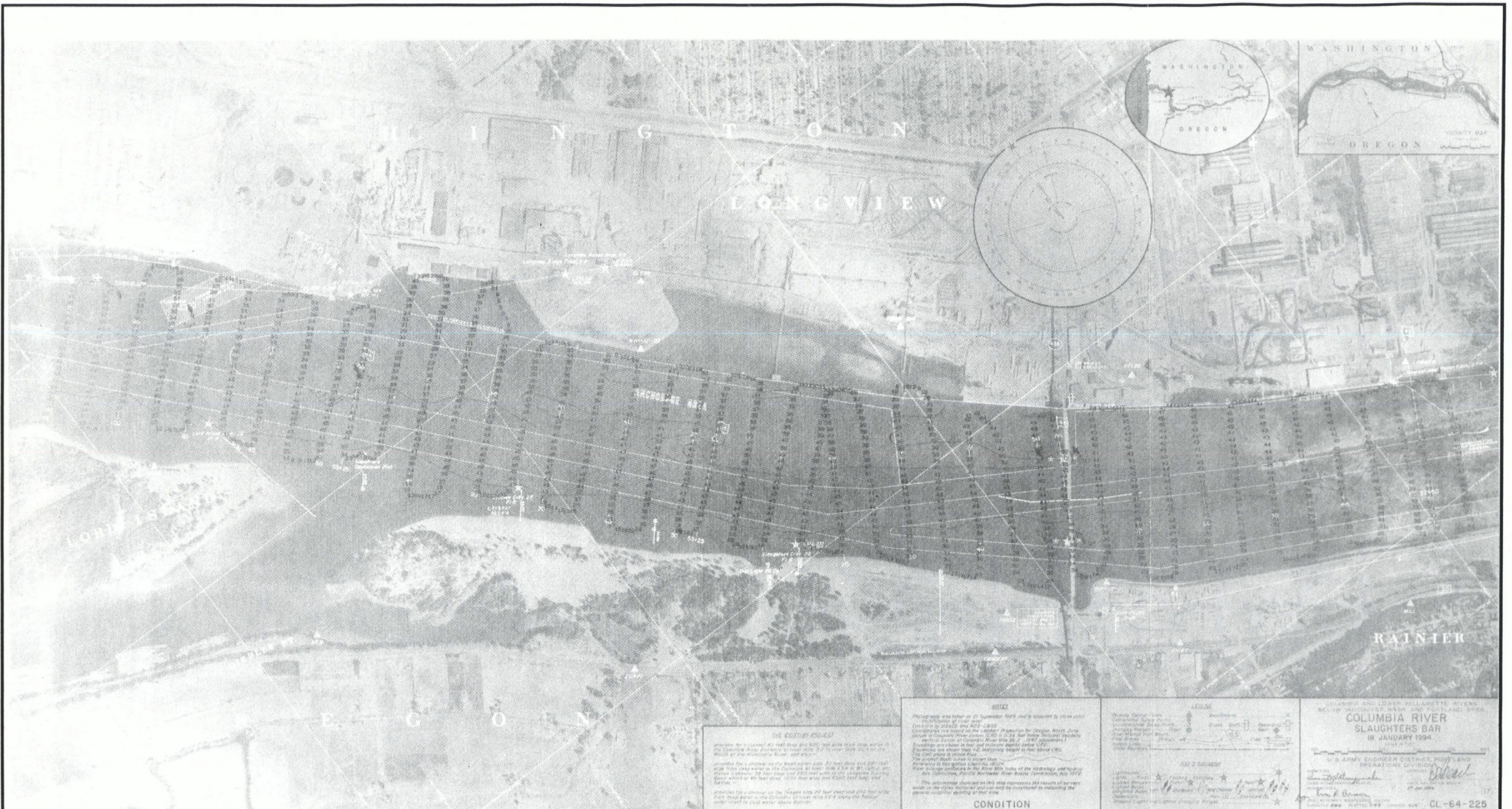


Figure 2
Columbia River Near Chlor-Alkali Plant
 WEYERHAEUSER CHLOR-ALKALI PLANT
 LONGVIEW, WASHINGTON

shown in Figure 2, the average depth of the river is reached from approximately 100 to 200 feet from shore and remains relatively even across the river.

Previous Sampling and Analysis

Sediment, surface water, and biological tissue have been sampled from the Columbia River near the Weyerhaeuser Chlor-Alkali plant numerous times since the 1970s. Table 1 summarizes mercury concentration results from samples of sediment and surface water collected during ten studies conducted between 1970 and 1993 (also see Appendix A). Table 2 summarizes mercury concentrations of biological tissue samples from five studies conducted between 1970 and 1993. A total of 61 sediment samples, 36 surface water samples, and 70 biological tissue samples have been collected since 1970 and are summarized below.

Sediment samples collected during the early 1970s from upstream of the Chlor-Alkali plant indicate mercury concentrations from below the method detection limit (MDL) to 0.28 milligram per kilogram (mg/kg). An upstream mercury mine located along the Tilton River, which feeds into the Cowlitz River, may have contributed to mercury concentrations in the sediment.

A T. W. Beak Consultants Limited (Beak) study suggested that mercury concentrations in sediment near the plant ranged from 8.0 to 19.0 mg/kg. A 1970 Weyerhaeuser study, which included collection of samples from similar locations, indicated mercury concentrations of 0.09 to 0.36 mg/kg. Sediment samples collected downstream of the Chlor-Alkali plant also did not appear to have good correlation. The Beak and Weyerhaeuser studies indicated that mercury concentrations in downstream sediment ranged from 0.12 to 6.4 mg/kg and 0.02 to 0.76 mg/kg, respectively.

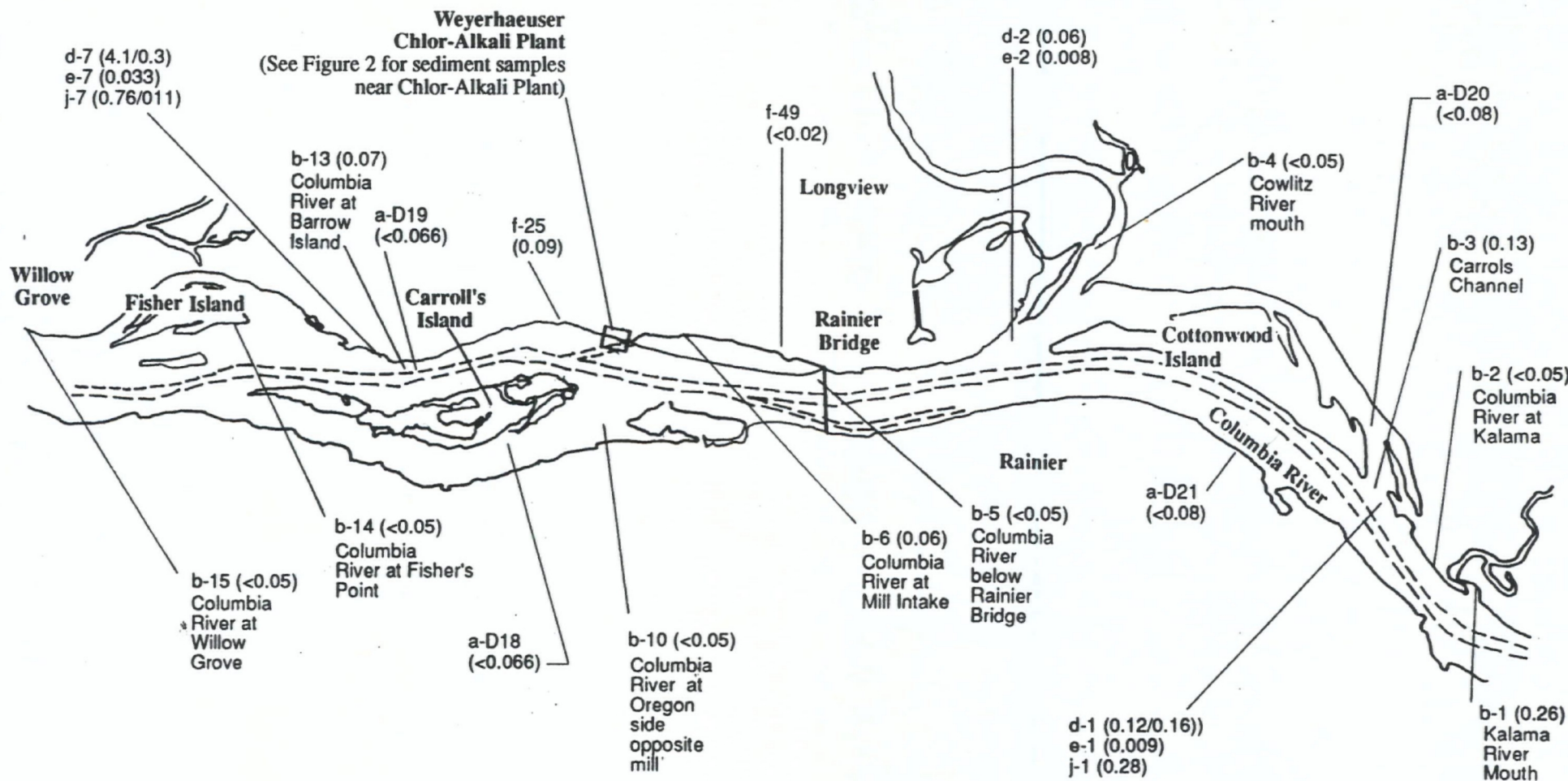
After the eruption of Mt. St. Helens in 1980, river dredging re-established the channel. Sediment sampling results indicated mercury concentrations upstream of the plant to be similar to those collected downstream of the plant. In 1986, results indicated a mercury concentration of 0.26 mg/kg at the mouth of the Kalama River, located upstream of the plant (Figure 3). Sediment samples collected after the Mt. St. Helens eruption and near the No. 1 Cell Room diffuser indicated mercury concentrations between 0.14 and 0.73 mg/kg. All other sediment samples collected near the plant had mercury concentrations below 0.2 mg/kg after 1980 (Figure 4). Sediment samples collected after the No. 1 Cell Room outfall and diffuser removal in 1992 were 0.3 to 7.2 mg/kg. This change may have been due to mobilizing contaminated sediment and/or debris from the diffuser removal in the outfall area. These samples may not have accurately represented the surrounding river sediment.

Biological tissue samples collected during the 1970s indicated higher mercury concentrations in all study areas compared with samples collected after 1980 (Table 2). After the Mt. St. Helens eruption, mercury concentrations in biological tissue were similar in the areas upstream, downstream, and near the plant.

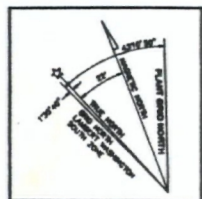
Table 1
Mercury Concentration Data for Sediment and Surface Water
Columbia River

Reference	Sediment Samples		Surface Water		Comments
	Dry Weight	Number of Samples	Samples	Number of Samples	
	Range (mg/kg)		Range (ug/L)		
UPSTREAM SAMPLE LOCATION (Approximately river mile markers 64 - 70)					
(d) Beak Consultants, 1970.	0.05/0.25; 0.08; 0.12/0.16 (Wet weight)	5	< 0.5; < 0.5; < 0.5	3	
(l) Weyerhaeuser, 1970.	0.07; 0.28; 0.40	3	-		
(e) Weyerhaeuser, 1973.	0.008; 0.029 (Wet weight)	2	< 0.2	1	
(b) Weyerhaeuser, 1986.	< 0.05; < 0.05; < 0.05; 0.08; 0.13; 0.26	6	< 0.2; < 0.2; < 0.2; < 0.2; < 0.2; < 0.2	6	Sample locations: 1, 2, 3, 4, 5, and 6.
(f) Johnson and Norton, 1988.	< 0.02	1	-		
(c) DOE, 1990.	0.008 J (Wet weight)	3	-		Background sample location: S-3.
(a) Tetra Tech, 1993.	< 0.079; < 0.08	2	< 0.5; < 0.5; < 0.5	3	Sample locations included W24, W25, W26, D20, and D21.
PLANT SAMPLE LOCATION (Approximate river mile marker 63.5)					
(d) Beak Consultants, 1970.	8.0; 19.0/19.0 (Wet weight)	3	< 0.5; < 0.5; < 0.5	3	
(l) Weyerhaeuser, 1970.	0.09 - 0.38	2	-		
(i) DOE, 1971.	0.3	1	< 1.0; < 1.0; 1.0	3	
(e) Weyerhaeuser, 1973.	0.33; 0.66 (Wet weight)	2	< 0.2	1	
(b) Weyerhaeuser, 1986.	< 0.05; < 0.05; 0.14; 0.15; 0.73	5	< 0.2; < 0.2; < 0.2; < 0.2; < 0.2	5	Sample locations: 7, 8, 9, 11, and 12.
(h) Sweet Edwards, 1987.	< 0.2	3	< 0.5		3 samples each for sediment and surface water.
(f) Johnson and Norton, 1988.	< 0.02; 0.02	2	-		
(c) DOE, 1990.	0.008; 0.011; 0.018 (Wet weight)	3	< 0.02; < 0.02	2	Sample locations: S-1 (Plant outfall), S-2 (west of outfall), S-3.
(g) CH2M HILL, 1992.	Before diffusional removal: < 0.2; < 0.2/< 0.2; 0.4; 0.6; 0.6	6	-		
	After diffusional removal: 0.3; 0.5; 2.3; 3.6; 7.2/0.5	6	-		
DOWNSTREAM SAMPLE LOCATION (Approximately 62.5 to 63 river mile marker)					
(d) Beak Consultants, 1970.	0.12; 4.1/0.3 (Wet weight)	3	< 0.5	1	
(l) Weyerhaeuser, 1970.	0.02; 0.60; 0.76	3	-		
(e) Weyerhaeuser, 1973.	0.23; 0.32; 0.33; 0.62 (Wet weight)	4	< 0.2	1	
(b) Weyerhaeuser, 1986.	< 0.05; < 0.05; < 0.05; 0.07	4	< 0.2; < 0.2; < 0.2; < 0.2	4	Locations included: 10, 13, 14, and 15.
(f) Johnson and Norton, 1988.	0.09	1	-		
(a) Tetra Tech, 1993.	< 0.068; < 0.068	2	< 0.5; < 0.5	2	Locations included: D18, D19, W22, and W23.
Notes:					
< = Value below detection limit posted.					
RM = River mile					
E or J = Indicates an estimated value when results are less than the specified quantification or detection limit.					
References: Refer to complete reference list at the end of this document.					
(a) Tetra Tech, Inc., 1993. Reference contains data for upstream, downstream, and site specific data.					
(b) Weyerhaeuser, 1986. Reference contains data for upstream, downstream, and site specific data.					
(c) DOE - Department of Ecology, 1990. Reference includes 2 samples (site data) and 1 upstream background sample.					
(d) Beak Consultants, 1970. Reference contains data for upstream, downstream, and site specific data.					
(e) Weyerhaeuser, 1973. Reference contains data for upstream, downstream, and site specific data.					
(f) Johnson and Norton, 1988. Reference contains data for upstream, downstream, and site specific sediment data.					
(g) CH2M HILL, 1992. Reference includes site specific data only.					
(h) Sweet Edwards, 1987. Reference includes 3 samples each for sediment and surface water.					
(i) DOE, Department of Ecology, 1971. Reference includes 1 site sample.					
(l) Weyerhaeuser, 1970. Reference includes data for upstream, downstream, and site specific data.					

Table 2 Mercury Concentrations for Biotissue Sampling (ppm wet weight)				
Study Event	Biotissue Type	Upstream	Site	Downstream
Beak, 1970	Coho	<0.04	0.18; 0.07	
	Sturgeon	0.3; 0.27	0.44	1.1; 1.1; 0.36
	Carp	0.32	1.8	
	Sucker		1.43	1.3; 0.63
	Chub	0.46		0.65
	Bullhead			7.9
	Squawfish	1.2; 0.53		2.0; 1.9
	Crayfish	0.19; 2.0	1.3; 1.0	0.5; 0.43
DOE, 1971	Mussels	0.24; 0.16; 0.36	0.26; 0.23; 0.30	
Weyerhaeuser, 1973	Sculpin	0.24; 0.53	0.51; 0.38	
	Crayfish	0.14; 0.19	0.51; 0.34	0.35; 0.51
	Flounder			0.08; 0.07
Fisher, 1986	Coho	0.03		0.05
	Sucker	0.03; <0.02	0.03	
	Flounder	0.04		0.03; 0.03
	Stickleback	0.08		<0.02; 0.04
	Sculpin	0.06	0.12; 0.04	0.07
	Smelt	<0.02		
				<0.02; <0.02
Tetra Tech, 1993	Sucker	0.061		0.072
	Crayfish	0.022		0.036
	Peamouth	0.095		0.094
	Sturgeon	0.094		



Note: Sample locations are approximate.

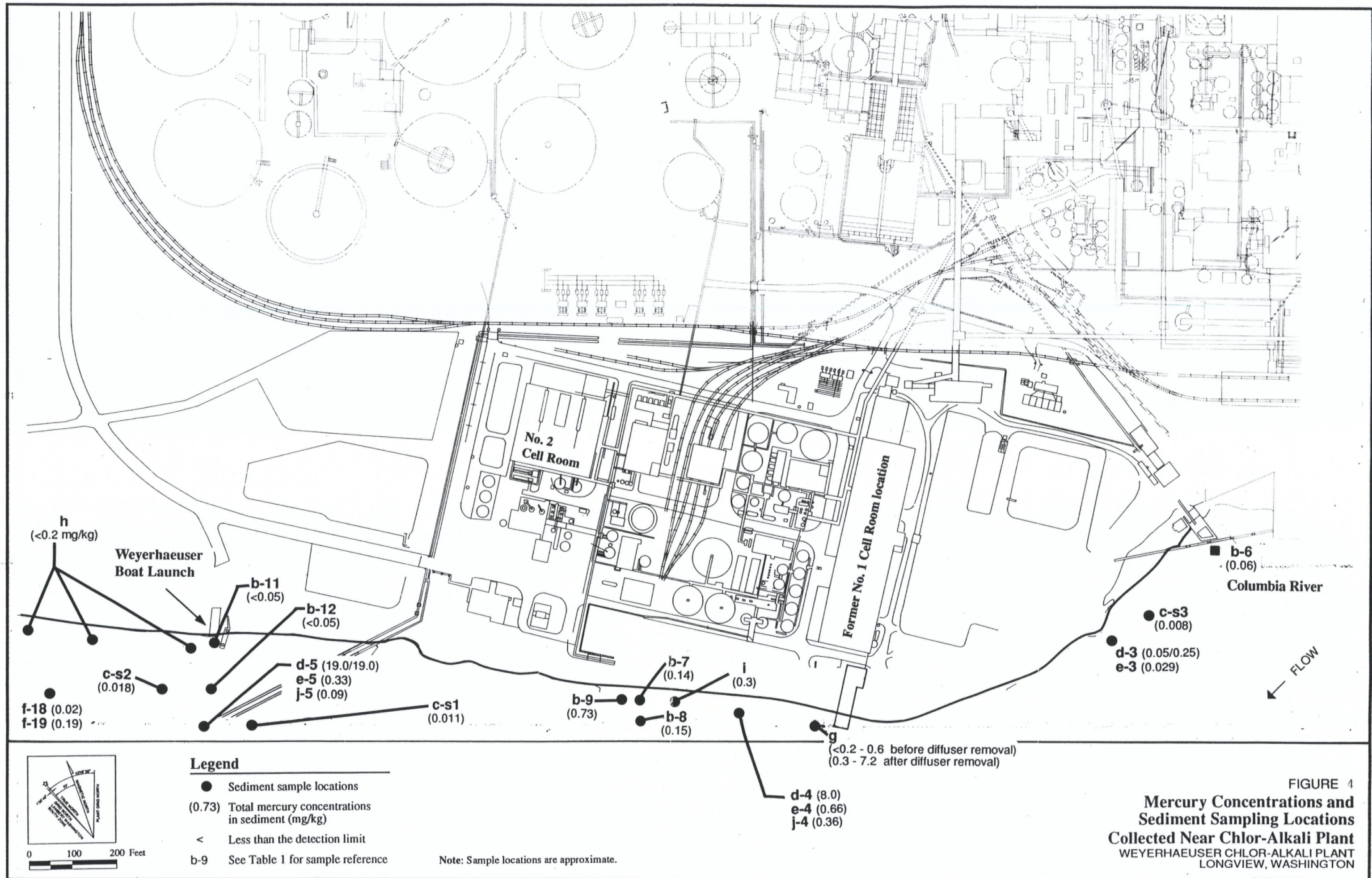


Legend

- (0.05) Mercury concentrations in sediment (mg/kg)
< Less than the detection limit

Note: a-D21: See Table 1 for reference "a" and sample "D21".

FIGURE 3
Mercury Concentrations and
Columbia River Sediment
Sampling Locations
WEYERHAEUSER CHLOR-ALKALI PLANT
LONGVIEW, WASHINGTON



The following paragraphs discuss individual sampling events and are listed in chronological order.

1970: Beak Consultants Study

In 1970, Weyerhaeuser contracted with Beak to investigate concentrations of mercury in water, sediment, and selected shellfish, fin fish, and benthic organisms. Laboratory analyses indicated concentrations of mercury in sediment collected upstream of the Chlor-Alkali plant ranged from 0.06 to 0.25 mg/kg, mercury concentrations downstream of the Chlor-Alkali plant ranged from 0.12 to 4.1 mg/kg, and mercury concentrations of sediment samples collected near the No. 1 Cell Room outfall were 8.0 mg/kg. Sediment samples collected approximately 1,500 feet downstream of the outfall were 19.0 mg/kg mercury. Laboratory analyses of surface water samples collected upstream of the plant, near the plant, and downstream of the plant indicated all samples contained less than the MDL of 0.0005 mg/L.

1970: Weyerhaeuser Study

During the Beak investigation of 1970, Weyerhaeuser collected samples from similar locations for soil, sediment, and biological tissue. Laboratory analyses of the Beak and Weyerhaeuser studies are poorly correlated. Sediment samples collected upstream of the plant indicated mercury concentrations from 0.07 to 0.40 mg/kg. Mercury concentrations in sediment collected near the Chlor-Alkali plant ranged from 0.09 to 0.36 mg/kg, while sediments collected downstream of the plant ranged from 0.02 to 0.76 mg/kg.

1971: Washington Department of Ecology Study

In 1970 and 1971, the Washington Department of Ecology (DOE) initiated cooperative studies with the Food and Drug Administration, the Water Quality Office of the Environmental Protection Agency, the Washington State Department of Game, and the Department of Oceanography of the University of Washington. Industrial and municipal wastewater, fish and shellfish tissue, freshwater and marine sediments, coal, and water samples from selected state areas were analyzed for mercury content.

One sediment sample was collected 100 yards downstream of the Chlor-Alkali plant discharge; laboratory analysis indicated a mercury concentration of 0.3 mg/kg. One water sample was collected from upstream of the plant, downstream of the plant, and near the Chlor-Alkali plant, for a total of three water samples. The water samples collected from upstream and downstream of the plant indicated mercury concentrations below the MDL of 0.001 mg/L.. The sample collected near the plant indicated a mercury concentration of 0.001 mg/L.

The DOE report discussed mercury mine drainage and stated that an effort was made to measure natural or background levels of mercury in drainage from mining areas. The report identified the Roy mine located near Morton, Washington. Water samples from the Tilton River, which receives drainage from this mining area and feeds into the Cowlitz River, showed that mercury concentrations were less than 0.0005 mg/L, and fish tissue collected

upstream and downstream from this mining area contained approximately 0.1 mg/kg of mercury.

1973: Weyerhaeuser Study

In 1973, Weyerhaeuser collected river water, sediment, and biological samples from locations similar to those sampled during the 1970 Beak investigation. Mercury concentrations in sediment upstream of the plant ranged from 0.008 to 0.029 mg/kg. Sediment samples collected near the Chlor-Alkali plant ranged from 0.33 to 0.66 mg/kg mercury, while samples collected downstream of the plant indicated mercury concentrations of 0.03 to 0.32 mg/kg. Water samples collected from the Columbia River were analyzed for mercury, and analysis indicated all samples were below the MDL of 0.0002 mg/L.

1986: Weyerhaeuser Study

In 1986, J. N. Fisher of the Weyerhaeuser Company conducted an investigation of mercury concentrations in soils, groundwater, surface water, process water, river sediments, and fish in the vicinity of the Chlor-Alkali plant. Mercury concentrations in sediment samples collected upstream of the plant ranged from below the MDL of 0.05 mg/kg to 0.26 mg/kg. The sample indicating a mercury concentration of 0.26 mg/kg was collected at the mouth of the Kalama River, which is approximately 5 miles upstream of the Chlor-Alkali plant (Figure 3). Sediment samples collected from near the plant were analyzed for mercury and ranged from below the MDL of 0.05 mg/kg to 0.73 mg/kg (Figure 4). One sample collected approximately 1,000 feet upstream of the No. 1 Cell Room outfall and two samples collected approximately 1,400 feet downstream of the No. 1 Cell Room outfall indicated mercury concentrations from below the MDL of 0.05 mg/kg to 0.06 mg/kg. Sediment samples collected downstream of the plant had mercury concentrations that ranged from below the MDL of 0.05 mg/kg to 0.07 mg/kg. As with the previous sampling events, laboratory analysis of water samples collected from upstream, downstream, and near the plant were below the MDL of 0.0002 mg/L (Figures 3 and 4).

1990: Washington Department of Ecology Inspection

The Washington Department of Ecology conducted a Class II inspection at the Weyerhaeuser Longview Pulp and Paper Mill in April 1990. Two water samples were collected near the pulp and paper mill outfall, which is approximately 1,400 feet downstream of the Chlor-Alkali plant outfall, and one water sample was collected approximately 2,000 feet upstream of the Chlor-Alkali plant. Laboratory results indicated each of the three samples were below the MDL of 0.0002 mg/L.

1992: Weyerhaeuser Independent Cleanup Action

In 1992, Weyerhaeuser conducted an independent cleanup action for the removal and disposal of the diffuser associated with the No. 1 Cell Room.

Five surface sediment samples were collected by underwater divers from immediately below the outfall and diffuser pipe before removal activities began. Sampling locations were flagged so that the same locations could be identified following the removal. After the diffuser was removed, underwater divers collected sediment samples from the flagged areas in a manner similar to the methodology previously used. Laboratory analysis indicated that mercury concentrations in the sediment before the removal ranged from below the MDL of 0.2 mg/kg to 0.6 mg/kg, while concentrations after the diffuser removal ranged from 0.3 mg/kg to 7.2 mg/kg. Sediment samples collected after the removal of the outfall system may have contained material that flowed from the discharge holes of the diffuser or cracks in the outfall system. The sediment samples collected after the outfall removal may not have accurately represented the river sediment.

1993: Tetra Tech Water Quality Study

In 1993, Tetra Tech conducted a study for the Lower Columbia River Bi-State Water Quality Program for water, sediment, tissue, and benthos from Bonneville Dam to the entrance into the Pacific Ocean. Sediment samples were collected approximately 9 miles upstream of the Chlor-Alkali plant and approximately 2 miles downstream of the plant. Laboratory results indicated mercury concentrations below 0.08 mg/kg for both samples. Water samples collected upstream and downstream of the plant indicate mercury concentrations below the MDL of 0.0005 mg/L.

Dredging Activities

Information regarding dredging activities was obtained at the COE Portland District, located in Portland, Oregon.

The Columbia River is divided into segments for identification purposes. Weyerhaeuser is located in the Slaughters Bar segment, which is approximately 4 miles long. The Lower Dobelbower Bar is upstream to the east, and the Walker Island Reach is downstream to the west.

The COE has been authorized to maintain a channel 600 feet wide and 40 feet deep from Columbia River mile 3.0 to mile 101.4. In addition, the COE has been authorized to maintain two side channels in Slaughters Bar. One of the side channels is located on the Washington side of the Columbia River. The side channel on the Washington side consists of a channel 30 feet deep and 300 feet wide from the deep water in the Columbia at river mile 63.4 to Mt. Coffin and then a channel 28 feet deep and 250 feet wide to the Longview Turning Basin, which is 40 feet deep, 1,200 feet wide, and 5,500 feet long (Figure 2). The COE is not authorized to dredge material in any areas of Slaughters Bar other than the main and side channel.

Typically, dredging does not occur in the main channel of Slaughters Bar near the Chlor-Alkali plant. However, sediment from the Cowlitz River, located in the lower Dobelbower Bar, is dredged nearly each year from the eastern portion of Slaughters Bar.

There are three locations in the side channel of Slaughters Bar and along the banks of the Weyerhaeuser forest products complex that have been dredged nearly every year from 1971 to 1988; no dredging has occurred since 1988. Table 3 indicates the dredging schedule from 1971 to the present. Maintenance dredging occurred near the cargo dock, which is located slightly upstream of the Chlor-Alkali plant, at an average rate of approximately 151,000 cubic yards per year for 11 of the 16 years between 1971 and 1988. Dredge spoils from the cargo dock were disposed of on Cottonwood Island, at the Reynolds Metals aluminum reduction plant, at Weyerhaeuser's east power house, or back into the Columbia River. In 1972, approximately 129,000 cubic yards was dredged from the salt dock area at the Chlor-Alkali plant and disposed of on Cottonwood Island.

Table 3
Maintenance Dredging Schedule from 1971 to Present
(cubic yards)

Year	Cargo Dock		Salt Dock		Log/Chip Barge Area	
	Dredged Volume	Disposal Area	Dredged Volume	Disposal Area	Dredged Volume	Disposal Area
1971	2,400	Cottonwood Island	—	—	142,850	Cottonwood Island
1972	—	Cottonwood Island	128,670	Cottonwood Island	172,444	Cottonwood Island
1973	209,701	Reynolds	—	—	191,664	Cottonwood Island
1974	58,885	Cottonwood Island	—	—	—	Cottonwood Island
1976	51,453	Cottonwood Island	—	—	54,057	Cottonwood Island
1977	—	—	—	—	43,169	Cottonwood Island
1978	—	—	—	—	4,553	Cottonwood Island
1979	—	—	—	—	—	Cottonwood Island
1980	465,387	E. power house	—	—	81,750	Cottonwood Island
1981	108,092	E. power house	—	—	55,200	Cottonwood Island
1982	169,051	E. power house	—	—	60,456	—
1983	166,650	E. power house	—	—	90,881	Cottonwood Island
1984	169,602	E. power house	—	—	27,961	Cottonwood Island
1985	—	—	—	—	—	—
1986	112,000	In water	—	—	30,000	Cottonwood Island
1988	150,000	In water	—	—	—	—
1989	—	—	—	—	—	—
1990	—	—	—	—	—	—
1991	—	—	—	—	—	—
1992	—	—	—	—	—	—
1993	134,000	In water	—	—	—	—
1994	—	—	—	—	—	—

—No dredging occurred.

Source: Data provided by K. Stalker of Weyerhaeuser, internal memorandum dated November 19, 1991.

Maintenance dredging also occurred at an average rate of approximately 80,000 cubic yards per year from the log/chip barge area, located upstream of the Chlor-Alkali plant, for 12 of the 16 years between 1971 and 1988, and dredge spoils were disposed of on Cottonwood Island.

After the eruption of Mt. St. Helens in 1980, the COE dredged a section along the bank of the Columbia River, which increased flow velocities and reduced sediment deposition in the side channel along the Weyerhaeuser forest products complex.

Current Conditions

Upstream of Plant

The most recent sediment sampling events (1988, 1990, and 1993) upstream of the Chlor-Alkali plant found mercury concentrations in sediment ranging from below MDL of 0.008 mg/kg to less than 0.08 mg/kg. Surface water samples collected upstream of the plant have all indicated mercury concentrations below the MDL of 0.0002 and 0.0005 mg/L. Biological tissue sampling data from 1986 and 1993 indicate mercury concentrations to be below 0.1 mg/kg.

Near Chlor-Alkali Plant

Sediment samples collected near the Chlor-Alkali plant during the same time frame (1988 and 1990) indicate mercury concentrations to be equal to or lower than those found upstream. The only exceptions are those samples collected immediately below the former No. 1 Cell Room diffuser, before and after removal. During the No. 1 Cell Room diffuser removal of 1992, laboratory analysis indicated mercury concentrations in sediment samples below the MDL to 0.6 mg/kg prior to diffuser removal and from 0.3 to 7.2 mg/kg after diffuser removal. All surface water samples collected near the plant suggested mercury concentrations in surface water to be below 0.001 mg/L except one sample collected in 1971, which showed a mercury concentration of 0.001 mg/L. Biological tissue data collected recently near the plant showed mercury concentrations to be below 0.13 mg/kg.

Downstream of Plant

Sediment sampling between 1988 and 1993 downstream of the Chlor-Alkali plant found mercury concentrations in sediment to range from below the MDL of 0.07 mg/kg to 0.09 mg/kg. This range is equal to or higher than the concentrations detected near the Chlor-Alkali plant and upstream of the plant during the same time period. If the more recent downstream studies are compared with the upstream studies, then mercury concentrations in sediment appear to be similar upstream and downstream of the Chlor-Alkali plant. Similarly, the downstream surface water samples indicated mercury concentrations below the MDL of 0.0002 and 0.0005 mg/L. Biological tissue samples collected during the 1986 and 1993 studies showed mercury concentrations in the tissue to be below 0.1 mg/kg.

Conclusions

The comparison of mercury sampling results between 1970 and 1993 indicates the following:

- Mercury concentrations in river sediments were highest in the 1970s.
- Studies performed after 1980 indicate a decline of mercury concentrations in sediment and biological samples.
- The decline in mercury concentrations is probably in response to the elimination of plant discharges, control of upstream source(s), natural attenuation, and the extensive river dredging conducted after the eruption of Mt. St. Helens in 1980.
- Recent sampling studies indicate mercury concentrations at the plant to be comparable to those detected upstream and downstream of the plant, except during the No. 1 Cell Room outfall and diffuser removal in 1992.
- Samples collected during the No. 1 Cell Room outfall and diffuser removal likely represent material that was contained in the outfall, rather than the river sediment.
- Biological tissue samples collected during the 1970s indicated higher mercury concentrations in all study areas of the Columbia River.
- Biological samples collected after the Mt. St. Helens eruption contained similar mercury concentrations in the areas upstream, downstream, and near the plant.
- Historic and recent sampling of surface water indicate that all samples collected upstream, downstream, and near the plant were all below the MDL except for one sample, which contained 0.001 mg/L mercury.

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Appendix A
Sediment and Surface Water
Sample Locations and Analysis

Appendix A

Sediment and Surface Water Sample Locations and Analyses						
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Study Event	Sediment Sample	Location Code	Mercury Concentration (mg/kg)	Surface Water Sample (mg/L)	Location Code	Mercury Concentration (µg/L)
Tetra Tech, 1993	D18	D	<0.066	W22	D	<0.05
	D19	D	<0.066	W23	D	<0.05
	D20	U	<0.079	W24	U	<0.05
	D21	U	<0.08	W25	U	<0.05
				W26	U	<0.05
CH2M HILL, 1992 (before diffuser removal)	3	P	0.4			
	4	P	0.6			
	5	P	<0.2			
	6	P	<0.2/<0.2			
	7	P	0.6			
CH2M HILL, 1992 (after diffuser removal)	3	P	2.3			
	4	P	0.5			
	5	P	3.6			
	6	P	7.2/0.5			
	7	P	0.3			
DOE, 1990	S1	P	0.011	S1	P	<0.02
	S2	P	0.018	S2	P	<0.02
	S3	P	0.008	S3	P	--
Johnson and Norton, 1988	18	P	0.02			
	19	P	<0.02			
	25	D	0.09			
	49	U	<0.02			

Sediment and Surface Water Sample Locations and Analyses

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Study Event	Sediment Sample	Location Code	Mercury Concentration (mg/kg)	Surface Water Sample (mg/L)	Location Code	Mercury Concentration (µg/L)
Weyerhaeuser, 1986	1	U	0.26	1	U	<0.02
	2	U	<0.05	2	U	<0.02
	3	U	0.13	3	U	<0.02
	4	U	<0.05	4	U	<0.02
	5	U	<0.05	5	U	<0.02
	6	U	0.06	6	U	<0.02
	7	P	0.14	7	P	<0.02
	8	P	0.15	8	P	<0.02
	9	P	0.73	9	P	<0.02
	10	D	<0.05	10	D	<0.02
	11	P	<0.05	11	P	<0.02
	12	P	<0.05	12	P	<0.02
	13	D	0.07	13	D	<0.02
	14	D	<0.05	14	D	<0.02
	15	D	<0.05	15	D	<0.02
Weyerhaeuser, 1973	1	U	0.009	A	U	<0.02
	2	U		B	P	<0.02
	3	U	0.029	C	D	<0.02
	4	P	0.66			
	5	P	0.33			
	5B	D	0.23			
	6	D	0.33			
	7	D	0.32			
	8	D	0.62			
DOE, 1971	1	P	0.3	1	U	<1.0
				2	P	1.0
				3	D	<1.0

Sediment and Surface Water Sample Locations and Analyses

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Study Event	Sediment Sample	Location Code	Mercury Concentration (mg/kg)	Surface Water Sample (mg/L)	Location Code	Mercury Concentration (µg/L)
Weyerhaeuser, 1970	1	U	0.28			
	2	U	0.40			
	3	U	0.07			
	4	P	---			
	5	P	0.36			
	6	D	0.09			
	7	D	0.76			
	8	D	0.02 0.60			
Beak, 1970	1	U	0.12/0.16	1	U	<0.05
	2	U	0.06	2	U	<0.05
	3	U	0.05/0.25	4	U	<0.05
	4	P	8.0	7	P	<0.05
	5	P	19.0/19.0	8	P	<0.05
	6	D	4.1/0.3	9	P	<0.05
	7	D	0.12	10	D	<0.05
Location code: U = upstream of plant D = downstream of plant P = near Chlor-Alkali plant						